CLAIMS

1. A speed reducer used in a yaw drive apparatus of a wind power generation apparatus, comprising:

a first stage speed reducing portion,

a second stage speed reducing portion connected to the first speed reducing portion, and

a third stage speed reducing portion,

wherein a total reduction gear ratio of a first stage speed reducing portion and a second speed reducing portion is set to 1/6 to 1/60,

the third stage speed reducing portion is constructed by an eccentric oscillating type speed reduction mechanism comprising an internal gear member in which internal teeth are formed at the internal periphery thereof, a plurality of external gears which are received in the internal gear member, which have external teeth engaged with the internal teeth and having number of teeth slightly less than that of the internal teeth at the external periphery thereof, and which are disposed in parallel to each other in the axial direction, a plurality of crank shafts which are rotatably inserted into the plurality of external gears, and which are connected to the second stage speed reducer and rotate to eccentrically rotate the plurality of external gears, and a carrier which rotatably supports both ends of the crank

shafts, and

a reduction gear ratio of the eccentric oscillating-type speed reduction mechanism is set to 1/50 to 1/140, and the total reduction gear ratio of the speed reducer is set to 1/1000 to 1/3000.

2. The speed reducer used in the yaw drive apparatus of the wind power generation apparatus according to claim 1,

wherein the first stage speed reducing portion is constructed by a planetary speed reduction mechanism including an input sun gear, a plurality of planetary gears engaged with the input sun gear at the periphery of the input sun gear, an internal gear member having internal teeth engaged with the plurality of the planetary gears at the periphery of the plurality of the planetary gears, and a carrier rotatably supporting the plurality of planetary gears, and

the second stage speed reducing portion is constructed by a spur gear type speed reduction mechanism including an input spur gear connected to the carrier of the planetary speed reduction mechanism, and a spur gear engaged with the input spur gear.

3. The speed reducer used in the yaw drive apparatus

of the wind power generation apparatus according to claim 1,

wherein the first stage speed reducing portion is constructed by a spur gear type speed reduction mechanism including a first input spur gear, and a first spur gear engaged with the first input spur gear, and

the second stage speed reducing portion is constructed by spur gear type speed reduction mechanism including a second input spur gear connected to the first spur gear, and a second spur gears engaged with the second input spur gear.

4. A yaw drive apparatus of a wind power generation apparatus using the speed reducer according to any one of claims 1 to 3,

wherein an output shaft of a motor is connected to an input part of a first stage speed reducing portion, and

an output part of an eccentric oscillating-type speed reduction mechanism is provided with external teeth engaged with a ring gear of a tower.

5. A yaw drive method of a wind power generation apparatus, in which a second gear engaged with a first gear attached to one of tower or a wind power generation

unit supported to the upper end of the tower so as to be capable of yawing and supported to a tower or to the upper end of the tower is rotated by a drive motor attached to the other of the tower or the wind power generation unit for yawing the wind power generation unit,

wherein a drive energy, which is supplied to the drive motor for a predetermined time from when the supply of the drive energy to the drive motor begins to start, is made to be smaller than the drive energy supplied to the drive motor in a common yawing.

6. The yaw drive method of a wind power generation apparatus according to claim 5,

wherein the drive energy, which is supplied to the drive motor for a predetermined period just before a point of time at which the supply of the drive energy to the drive motor is stopped to the point of time at which the supply of the drive energy is stopped, is made to be smaller than the drive energy supplied to the drive motor in a common yawing, and at the same time a predetermined value of braking torque is applied to the drive motor by the braking means after the supply of the drive energy to the drive motor is stopped.

7. The yaw drive method of a wind power generation

apparatus according to claim 5,

wherein a predetermined value of braking torque is applied to the drive motor by the braking means after the passage of a predetermined time from when the supply of the drive energy to the drive motor is stopped.

8. A yaw drive apparatus of a wind power generation apparatus, the yaw drive apparatus, comprising:

a first gear attached to one of tower and a wind power generation unit supported to the upper end of the tower so as to be capable of yawing,

a second gear engaged with the first gear,

a drive motor attached the other of the tower or the wind power generation unit, and rotates the second gear when the drive energy is supplied thereto, thereby yawing the wind power generation unit, and

a reduction means for making a drive energy, which is supplied to the drive motor for a predetermined time from when the supply of the drive energy to the drive motor begins to start, smaller than the drive energy supplied to the drive motor in a common yawing.

9. The yaw drive apparatus of the wind power generation apparatus according to claim 8,

wherein the drive energy which is supplied to the

drive motor for a predetermined period just before the supply of the drive energy until the drive motor is stopped to the point of time at which the supply of the drive energy is stopped, is made smaller than the drive energy supplied to the drive motor in a common yawing by the reduction means, and

wherein the yaw drive apparatus further comprises a braking means for applying a predetermined value of braking torque to the drive motor after the supply of the drive energy to the drive motor is stopped.

10. The yaw drive apparatus of the wind power generation apparatus according to claim 9,

wherein the drive motor and the second gear are plurally provided, and

wherein drive energy made to be small is supplied to a part of the drive motor by the reduction means even after the yawing of the wind power generation unit is stopped to rotate the second gear, such that the backlash between the teeth of the first gear and the teeth of the second gear is removed.

11. The yaw drive apparatus of the wind power generation apparatus according to claim 8,

wherein when the drive motor is composed of a fluid

motor, a pair of supply/discharge passages which supply and discharge the fluid to and from the fluid motor is connected to each other by a connection passage, and a throttle is interposed in the connection passage, such that the rotational speed of the fluid motor when it performs a pump operation is controlled by the throttle.

12. The yaw drive apparatus of the wind power generation apparatus according to claim 8,

wherein when the drive motor is composed of a fluid motor, a pair of supply/discharge passages which supply and discharge the fluid to and from the fluid motor is connected to each other by a connection passage, and a relief valve, which is switched into on-state when a pressure in one of the supply/discharge passages is raised to a value higher than a predetermined value, is interposed in the connection passage, such that the torque control of the fluid motor is performed by the relief valve when the fluid motor performs the pump operation.

13. The yaw drive apparatus of the wind power generation apparatus according to claim 9, further comprising:

an anemometer for measuring a wind direction,

wherein the drive motor is released from the braking caused by the braking means when the wind velocity measured by the anemometer is a predetermined value or more.

14. A yaw drive method of a wind power generation apparatus, in which a pinion, which is engaged with a ring-shaped internal gear attached to one of a tower or a wind power generation unit supported to the upper end of the towe so as to be capable of yawingr, is rotated by a drive motor attached to the other of the tower or the wind power generation unit for yawing the wind power generation unit,

wherein a drive energy, which is supplied to the drive motor for a predetermined time from when the supply of the drive energy to the drive motor begins to start, is made smaller than the drive energy supplied to the drive motor in a common yawing.

15. The yaw drive method of a wind power generation apparatus according to claim 14,

wherein the drive energy, which is supplied to the drive motor for a predetermined period just the supply of the drive energy to the drive motor is stopped until the supply of the drive energy is stopped, is made to be

smaller than the drive energy supplied to the drive motor in a common yawing, and at the same time a predetermined value of braking torque is applied to the drive motor by the braking means after the supply of the drive energy to the drive motor is stopped.

16. The yaw drive method of a wind power generation apparatus according to claim 14,

wherein a predetermined value of braking torque is applied to the drive motor by the braking means after the a predetermined time from when the supply of the drive energy to the drive motor is stopped.

17. A yaw drive apparatus of a wind power generation unit, the yaw drive apparatus comprising:

a ring-shaped internal gear attached to one of a tower or a wind power generation unit supported to the upper end of the tower so as to be capable of yawing,

a pinion engaged with the internal gear,

a drive motor attached the other of the tower or the wind power generation unit, and rotates the pinion when the drive energy is supplied thereto, thereby yawing the wind power generation unit,

and a reduction means a drive energy, which is supplied to the drive motor for a predetermined time from

when the supply of the drive energy to the drive motor begins to start, is smaller than the drive energy supplied to the drive motor in a common yawing.

18. The yaw drive apparatus of the wind power generation unit according to claim 17,

wherein the drive energy, which is supplied to the drive motor for a predetermined period just before the supply of the drive energy to the drive motor is stopped until the supply of the drive energy is stopped, is made smaller than the drive energy supplied to the drive motor in a common yawing by the reduction means, and

wherein the yaw drive apparatus further comprises a braking means for applying a predetermined value of braking torque to the drive motor after the supply of the drive energy to the drive motor is stopped.

19. The yaw drive apparatus of the wind power generation unit according to claim 18,

wherein the drive motor and the pinion gear are plurally provided, and

wherein drive energy made to be small is supplied to a part of the drive motor by the reduction means even after the yawing of the wind power generation unit is stopped to rotate the pinion, such that the backlash

between the teeth of the pinion and the teeth of the internal gear is removed.

20. The yaw drive apparatus of the wind power generation unit according to claim 17,

wherein when the drive motor is composed of a fluid motor, a pair of supply/discharge passages which supply and discharge the fluid to and from the fluid motor is connected to each other by a connection passage, and a throttle is interposed in the connection passage, such that the rotational speed of the fluid motor when it performs a pump operation is controlled by the throttle.

21. The yaw drive apparatus of the wind power generation unit according to claim 17,

wherein when the drive motor is composed of a fluid motor, a pair of supply/discharge passages which supply and discharge the fluid to and from the fluid motor is connected to each other by a connection passage, and a relief valve, which is switched into on-state when a pressure in one of the supply/discharge passages is raised to a value higher than a predetermined value, is interposed in the connection passage, such that the torque control of the fluid motor is performed by the relief valve when the fluid motor performs the pump

operation.

22. The yaw drive apparatus of the wind power generation unit according to claim 18, further comprising:

an anemometer for measuring a wind direction,

wherein the drive motor is released from the braking caused by the braking means when the wind velocity measured by the anemometer is a predetermined value or more.